Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C10c
Effective
Date: 10/31/16

Technical Standard Order

Subject: PRESSURE ALTIMETER SYSTEM

1. PURPOSE. This technical standard order (TSO) is for manufacturers of pressure actuated sensitive type altimeter equipment applying for a TSO authorization (TSOA) or letter of design approval (LODA). In it, we (the Federal Aviation Administration, (FAA)) tell you what minimum performance standards (MPS) your pressure actuated sensitive type altimeter equipment must first meet for approval and identification with the applicable TSO marking.

2. APPLICABILITY. This TSO affects new applications submitted after its effective date.

a. TSO-C10b will remain effective until April 30, 2018. After this date, we will no longer accept applications for TSO-C10b.

b. Altimeter equipment approved under a previous TSOA may still be manufactured under the provisions of its original approval.

3. REQUIREMENTS. New models of pressure altimeter equipment identified and manufactured on or after the effective date of this TSO must meet the MPS and documentation requirements in the Society of Automotive Engineers (SAE) International's Aerospace Standard (AS) 8009C, *Pressure Altimeter Systems*, dated May 24, 2016, as modified by appendix 1 of this TSO.

a. Functionality. This TSO's standards apply to equipment intended to respond to pressure changes with a high degree of graduated and calibrated sensitivity and used primarily in aircraft for finding distance above sea level, terrain, or some other reference point by a comparison of air pressures.

b. Failure Condition Classification. There is no standard minimum failure condition classification for this TSO. The failure condition classification appropriate for the equipment will depend on the intended use of the equipment in a specific aircraft. Document the loss of function and malfunction failure condition classification for the equipment design.

c. Functional Qualification. This TSO does not define the test procedures to verify functional performance. The manufacturer must define the appropriate tests to verify compliance with SAE/AS8009C as modified by appendix 1 of this TSO.

d. Environmental Qualification. Demonstrate the required performance under the test conditions specified in SAE/AS8009C, Section 6, as modified by appendix 1 of this TSO, using standard environmental conditions and test procedures appropriate for airborne equipment. You may use a different standard environmental condition and test procedure than RTCA/DO-160G, provided the standard is appropriate for the pressure altimeter equipment.

> **Note:** The use of RTCA/DO-160D (with Changes 1 and 2 only, without Change 3 incorporated) or earlier versions is generally not considered appropriate and will require substantiation via the deviation process as discussed in paragraph **3.g** of this TSO.

e. Software Qualification. If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178C, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 13, 2011, including referenced supplements as applicable, to at least the software level consistent with the failure condition classification defined in paragraph **3.b** of this TSO. You may also develop the software according to RTCA, Inc. document RTCA/DO-178B, dated December 1, 1992 if you follow the guidance in AC 20-115C, *Airborne Software Assurance*, dated July 19, 2013.

f. Electronic Hardware Qualification. If the article includes complex custom airborne electronic hardware, develop the component according to RTCA, Inc. document RTCA/DO-254*, Design Assurance Guidance for Airborne Electronic Hardware,* to at least the design assurance level consistent with the failure condition classification defined in paragraph **3.b** of this TSO. For custom airborne electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies.

g. Deviations. We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show your equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 14 CFR § 21.618.

4. MARKING.

a. Mark at least one major component permanently and legibly with all the information in 14 CFR § 45.15(b). The marking must include the serial number. Mark the maximum calibrated altitude on both the nameplate and dial.

b. Also, mark the following permanently and legibly, with at least the manufacturer's name, subassembly part number, and the TSO number:

(1) Each easily removable component (without hand tools); and,

(2) Each subassembly of the article you determined may be interchangeable.

c. If the article includes software and/or airborne electronic hardware, then the article part numbering scheme must identify the software and airborne electronic hardware

configuration. The part-numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware.

d. You may use electronic part marking to identify software or airborne electronic hardware components by embedding the identification within the hardware component itself (using software) rather than marking it on the equipment nameplate. If electronic marking is used, it must be readily accessible without the use of special tools or equipment.

5. APPLICATION DATA REQUIREMENTS. You must give the FAA aircraft certification office (ACO) manager responsible for your facility a statement of conformance, as specified in 14 CFR § 21.603(a)(1) and one copy each of the following technical data to support your design and production approval. LODA applicants must submit the same data (excluding paragraph **5.g**) through their civil aviation authority.

a. A Manual(s) containing the following:

(1) Operating instructions and equipment limitations sufficient to describe the equipment's operational capability. State the maximum calibrated altitude.

(2) Describe in detail any deviations.

(3) Installation procedures and limitations sufficient to ensure the pressure altimeter equipment, when installed according to the installation or operational procedures, still meet this TSO's requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statement:

> "This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval."

(4) For each unique configuration of software and airborne electronic hardware, reference the following:

(a) Software part number including revision and design assurance level;

(b) Airborne electronic hardware part number including revision and design assurance level; and,

(c) Functional description.

(5) A summary of the test conditions used for environmental qualifications for each component of the article. For example, a form as described in RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment,* Appendix A.

(6) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the pressure altimeter equipment.

(7) List of replaceable components, by part number, making up the pressure altimeter equipment. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of the pressure altimeter equipment. Include recommended inspection intervals and service life, as appropriate.

c. If the article includes software: a plan for software aspects of certification (PSAC), software configuration index, and software accomplishment summary.

d. If the article includes simple or complex custom airborne electronic hardware: a plan for hardware aspects of certification (PHAC), hardware verification plan, top-level drawing, and hardware accomplishment summary (or similar document, as applicable).

e. A drawing depicting how the article will be marked with the information required by paragraph **4** of this TSO.

f. Identify functionality or performance contained in the article not evaluated under paragraph **3** of this TSO (i.e., non-TSO functions). Non-TSO functions are accepted in parallel with the TSO authorization. For those non-TSO functions to be accepted, you must declare these functions and include the following information with your TSO application:

(1) Description of the non-TSO function(s), such as performance specifications, failure condition classifications, software, hardware, and environmental qualification levels. Include a statement confirming the non-TSO function(s) do not interfere with the article's compliance with the requirements of paragraph **3**.

(2) Installation procedures and limitations sufficient to ensure the non-TSO function(s) meets the declared functions and performance specification(s) described in paragraph **5.f.(1)**.

(3) Instructions for continued performance applicable to the non-TSO function(s) described in paragraph **5.f.(1).**

(4) Interface requirements and applicable installation test procedures to ensure compliance with the performance data defined in paragraph **5.f.(1).**

(5) Test plans, analysis and results, as appropriate, to verify performance of the hosting TSO article is not affected by the non-TSO function(s).

(6) Test plans, analysis and results, as appropriate, to verify the function and performance of the non-TSO function(s) as described in paragraph **5.f.(1).**

g. The quality system description required by 14 CFR § 21.608, including functional test specifications. The quality system should ensure you will detect any change to the approved design could adversely affect compliance with the TSO MPS, and reject the article accordingly. (Not required for LODA applicants.)

h. Material and process specifications list.

i. List of all drawings and processes (including revision level) defining the article's design.

j. Manufacturer's TSO qualification report showing results of testing accomplished according to paragraph **3.c** of this TSO.

6. MANUFACTURER DATA REQUIREMENTS. Besides the data given directly to the responsible ACO, have the following technical data available for review by the responsible ACO:

a. Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

b. Equipment calibration procedures.

c. Schematic drawings.

d. Wiring diagrams.

e. Material and process specifications.

f. The results of the environmental qualification tests conducted according to paragraph **3.d** of this TSO.

g. If the article includes software, the appropriate documentation defined in RTCA/DO-178B or RTCA/DO-178C specified in paragraph **3.e** of this TSO, including all data supporting the applicable objectives in RTCA/DO-178B Annex A, *Process Objectives and Outputs by Software Level*.

h. If the article includes complex custom airborne electronic hardware, the appropriate hardware life cycle data in combination with design assurance level, as defined in RTCA/DO-254, Appendix A, Table A-l. For simple custom airborne electronic hardware, the following data: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records, including problem reports.

i. If the article contains non-TSO function(s), you must also make available items **6.a** through **6.h** as they pertain to the non-TSO function(s).

7. FURNISHED DATA REQUIREMENTS.

a. If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one copy or on-line access to the data in paragraphs **5.a**

and **5.b** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the Altimeter equipment.

b. If the article contains declared non-TSO function(s), include one copy of the data in paragraphs **5.f.(1)** through **5.f.(4).**

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order RTCA documents from RTCA Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at www.rtca.org.

b. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also order copies online at www.sae.org.

c. Order copies of 14 CFR parts 21 and 45 from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis, MO 63197. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at www.gpo.gov.

d. You can find a current list of technical standard orders and advisory circulars on the FAA Internet website Regulatory and Guidance Library at http://rgl.faa.gov/. You will also find the TSO Index of Articles at the same site.

Richard E. Jennings
Acting Manager, Design, Manufacturing, &
Airworthiness Division
Aircraft Certification Service

APPENDIX 1. MINIMUM PERFORMANCE STANDARD FOR PRESSURE ALTIMETER SYSTEM

This appendix defines modifications and additions to the MPS for pressure altimeter equipment specified in SAE/AS8009C, *Pressure Altimeter Systems*, dated May 24, 2016.

SAE/AS8009C Section(s)	Change
3.4	**Add a note following the paragraph to read:** **Note:** Markings for the altitude range may be omitted for instruments using a tape-type display.
3.10	**Delete current section 3.10 and Table 9. Replace with the following:** **3.10 Temperature Corrections** Altimeters covered by this standard shall not incorporate automatic temperature corrections.
3.11	**Add new 3rd paragraph to read:** Instruments using a tape-type display or presenting altitude with a digital readout are permitted to use tic marks every 100 feet with a more prominent mark every 500 feet in agreement with SAE/ARP4102/7, Appendix A, Symbols 39 and 40.
3.12	**Change the 3rd sentence to read:** The word ALTITUDE or ALT may be marked on the dial in capital letters and may be in the same finish as the numerals.
3.12	**Add a note following the paragraph to read:** **Note:** Markings for the altitude range may be omitted for instruments using a tape-type display.
5.11	**Add a requirement for performance testing of Electronic Display Altimeters:** Electronic displays shall demonstrate their compliance with the SAE/AS8034B requirements specified in Table 10 using the test procedures specified in SAE/AS8034B, Section 6, as applicable.
6.29	**Add a requirement for environmental testing of Electronic Display Altimeters:** Electronic displays shall demonstrate their equipment compliance with the requirements of SAE/AS8034B specified in Table 10 using the environmental performance requirements specified in SAE/AS8034B, Section 5.